WATER-RESOURCES INVESTIGATIONS OPEN-FILE REPORT 79-1070 PREPARED IN COOPERATION WITH THE DEPARTMENT OF THE INTERIOR ARIZONA WATER COMMISSION DEPTH TO WATER AND ALTITUDE OF THE WATER LEVEL UNITED STATES GEOLOGICAL SURVEY R. 8 W. 112°45' R. 4 W. R. 3 W. R. 2 W. 112°30' R. 1 W. R. 1 E. 112°15' R. 9 W. 113°15' R. 2 E. COCONINO COUNT T. 42 N 4520 Several springs issue from the basalt in the Mount Trumbull area. The estimated discharge from four of the springs is 2 gal/min or less. Water from a spring in sec. 19, T. 34 N., R. 8 W., contains 68 mg/L 36°1 sulfate, 326 mg/L dissolved solids, and 0.1 mg/L fluoride. The chemical quality of the water from the spring probably is typical of that for the water in the basalt (see sheet 2). The N aquifer is present in the extreme north-central part of the area. In most of its area of outcrop the aguifer has been drained of water as a result of canyon cutting. Where the aquifer is saturated but not highly fractured, wells generally yield less than 25 gal/min; where the

level. Figure, 2, next to symbol indicates number of wells at this location SPRING First entry, Jan, is aquifer from which the spring JEn 9 34.9M(1976) issues (see composite stratigraphic column for explanation of letter symbol). Second entry, 34.9M(1976), is discharge of spring in gallons per minute [R, discharge reported; M, discharge measured; E, discharge estimated; (1976), year in which discharge was determined]. Third entry, 4960, is altitude of the land surface in feet above mean sea level EXPLORATION HOLE—Letter symbol, Pk , is oldest geologic unit penetrated (see composite stratigraphic column for explanation of letter symbol) APPROXIMATE AREA IN WHICH DEPTH TO WATER PROBABLY IS LESS THAN 100 FEET BELOW LAND SURFACE ARBITRARY BOUNDARY OF GROUND-WATER AREA CONVERSION FACTORS

EXPLANATION

WELL—First entry, km, is principal aquifer (see composite

Second entry, 15M(1976), is depth to water in feet below

water measured; E, depth to water estimated; (1976), year

in which water level was determined]. Third entry, 4860,

land surface [R; depth to water reported; M, depth to

is altitude of the water level in feet above mean sea

stratigraphic column for explanation of letter symbol).

For use of those readers who may prefer to use metric units rather than inch-pound units, the conversion factors for the terms used in this report are listed below: To obtain metric unit Multiply inch-pound unit meter (m) 0.3048 foot (ft) square mile (mi²) square kilometer (km2) 2.590 0.001233 cubic hectometer (hm) acre-foot (acre-ft) liter per second gallon per minute 0.06309 (L/s) (gal/min) 0.2070 liter per second per gallon per minute per

meter [(L/s)/m]

Alluvium along the washes in the Short Creek-Cane Beds area yields as much as 200 gal/min to irrigation wells. Most of the irrigation wells are less than 100 ft deep, and the depth to water generally is less than 50 ft below the land surface. In the rest of the Kanab area, however, the alluvium along some of the washes may yield less than 5 gal/min. Three test holes along Two Mile Wash penetrated 44 to 83 ft of alluvium and bottomed in the underlying Moenkopi Formation. The test holes were abandoned because of the poor chemical quality of the water.

During the drilling of the test holes, the water was sampled at differ-

ent depths, and the specific conductance ranged from 1,500 to 2,700

micromhos per centimeter at 25°C. Specific conductance is an indica-

INTRODUCTION

The Kanab area includes about 3,500 mi in northwestern Arizona. Ground

water is obtained from several aquifers that are made up of one or more

are not hydraulically connected because of intervening impermeable beds.

formations. Many of the aquifers overlie one another, but they generally

The composite stratigraphic column indicates the relative position of the

formations. Units that yield water to wells and springs are, in descend-

ing order, the alluvium; basalt; N aquifer, which consists of the Navajo

Sandstone, Kayenta Formation, and Moenave Formation; Shinarump Member of

Devonian and Cambrian rocks may constitute a regional aquifer; however,

the rocks are at depths of 3,000 ft or more in most of the area and have

underlie most of the Kanab area, they are dry in places. Ground-water

slightly more than 2,000 acre-ft, most of which was used for irrigation

in the Short Creek-Cane Beds area. Most wells, however, are used for

domestic and stock purposes. In areas of high well or spring density,

The hydrologic data on which these maps are based are available, for the

most part, in computer-printout form for consultation at the Arizona

Street, Tucson; Valley Center, Suite 1880, Phoenix; and 2255 North

Water Commission, 222 North Central Avenue, Suite 800, Phoenix, and at

U.S. Geological Survey offices in: Federal Building, 301 West Congress

Gemini Drive, Building 3, Flagstaff. Material from which copies can be

GROUND WATER

made at private expense is available at the Tucson, Phoenix, and Flagstaff

the Chinle Formation; Moenkopi Formation; Kaibab Limestone; Toroweap

Formation; Coconino Sandstone; Supai Group; and Muav Limestone. The

not been tapped by water wells. Although several of the aquifers

development has been slight, and in 1976 the estimated pumpage was

only selected wells and springs are shown on the map.

offices of the U.S. Geological Survey.

tion of the dissolved-solids concentration in the water (see sheet 2). The dissolved-solids value may be estimated by multiplying the specific conductance by 0.7, which is the average ratio of dissolved solids to specific conductance in the Kanab area. The ratio was computed using 28 samples for which specific conductance and dissolved solids were determined. Water samples from eight wells in the alluvium contain 14 to 1,500 mg/L (milligrams per liter) sulfate, 253 to 2,240 mg/L dissolved solids, and 0.2 to 1.3 mg/L fluoride. The recommended limit for sulfate concentrations in drinking water is 250 mg/L (National Academy of Sciences and National Academy of Engineering, 1973, p. 89); sulfate concentrations in water in the alluvium generally are more than 250 mg/L. The proposed secondary maximum contaminant level for dissolved solids in public water supplies is 500 mg/L (U.S. Environmental Protection Agency, 1977, p. 17146). The maximum contaminant level for fluoride in public water supplies differs according to the annual average maximum daily air temperature (Bureau of Water Quality Control, 1978, p. 6). The amount of water consumed by humans, and therefore the amount of fluoride ingested, depends partly on air temperature. In the developed part of the Kanab area the annual average maximum daily air temperature is about 70°F, and the maximum contaminant level for fluoride is 1.8 mg/L.

aquifer is intensely fractured, however, such as along the major fault near Moccasin, wells yield more than 250 gal/min. In the Moccasin-Pipe Spring National Monument area faulting has abutted the N aquifer against impermeable beds in the Chinle and Moenkopi Formations. The impermeable beds are a barrier to the movement of ground water, and the water is forced to the land surface where it issues from numerous springs that discharge less than 1 to more than 200 gal/min. In the Moccasin area nine wells that penetrate the N aquifer are 70 to 309 ft deep. The depth to water ranges from 4 to 80 ft below the land surface, and well yields range from 25 to 480 gal/min. In five wells tested, the specific capacity ranges from 5.8 to 25 (gal/min)/ft of drawdown. A well in the NW4 sec. 32, T. 42 N., R. 5 W., is 250 ft deep, the depth to water is 105 ft below the land surface, the yield is 25 gal/min, and the specific capacity is 0.3 (gal/min)/ft of drawdown. The water in the N aquifer is of suitable chemical quality for domestic use. Calcium, magnesium, and bicarbonate are the dominant constituents. Ten water samples from wells and springs in the N aquifer contain 119 to 307 mg/L dissolved solids and 0.0 to 0.3 mg/L fluoride.

The Shinarump Member of the Chinle Formation yields water to wells and springs in the north-central part of the area. Wells are 45 to 490 ft deep, but most are less than 250 ft deep. The depth to water ranges from 1 to 418 ft below the land surface; however, most water levels are less than 200 ft below the land surface. The reported yield from six wells ranges from 0.5 to 500 gal/min, and the estimated discharge for three springs is less than 5 gal/min each. In water samples from wells and springs in the Shinarump the dissolved-solids concentrations range from 248 to 2,340 mg/L, sulfate concentrations range from 12 to 1,300 mg/L, and fluoride concentrations range from 0.0 to 1.0 mg/L (see sheet 2).

The Moenkopi Kanab area. Wells that penetrate the formation are 16 to 895 ft deep. The reported depth to water ranges from 12 to 426 ft below the land surface, and capacity for three wells is 0.03, 0.05, and 1.6 (gal/min)/ft of drawdown. Dissolved-solids concentrations range from 2,710 to 6,250 mg/L, sulfate concentrations range from 1,400 to 3,800 mg/L, and fluoride concentrations range from 0.2 to 0.5 mg/L (see sheet 2).

The Kaibab Limestone reportedly yields water to six wells in the northern part of the area. The wells are 400 to 693 ft deep, depth to water ranges from 375 to 575 ft below the land surface, and well yields range from 1.5 to 10 gal/min. The specific capacity for a well in sec. 18, T. 39 N., R. 1 W, is 0.03 (gal/min)/ft of drawdown. Water samples were collected from two wells that penetrate the Kaibab Limestone—one in sec. 18, T. 39 N., R. 1 W., and one in sec. 24, T. 39 N., R. 4 W. (see sheet 2). Water samples were collected at 538 and 690 ft during drilling of the well in sec. 18. Although the concentrations of dissolved solids, calcium, sulfate, and fluoride increased with depth, the concentrations of bicarbonate, chloride, magnesium, sodium, and potassium decreased with depth. The dissolved-solids concentrations are 1,450 mg/L at 538 ft and 2,220 mg/L at 690 ft in the water from the well in sec. 18 and 3,100 mg/L in the water from the well in sec. 24. Fluoride concentrations are 1.5 mg/L at 538 ft and 2.0 mg/L at 690 ft in the water from the well in sec. 18 and 1.4 mg/L in the water from the well in sec. 24.

Toroweap but is dry. The chemical quality of the water in the Toroweap is unknown.

Three springs issue from the Coconino Sandstone in the east-central part of the area. The discharge for one of the springs is unknown; the other springs discharge 25 and 50 gal/min. Calcium and bicarbonate are the dominant chemical constituents in the water. Dissolved-solids concentrations range from 205 to 345 mg/L, and fluoride concentrations range from 0.1 to 0.2 mg/L (see sheet 2).

The Toroweap Formation is reported to be the source of three springs

that discharge 0.7, 9, and 10 gal/min in the southeastern part of the

area. A well in sec. 20, T. 35 N., R. 7 W., reportedly penetrates the

1968). Partial chemical analyses of the water from the two springs indicate that calcium and bicarbonate are the dominant constituents (see sheet 2).

SELECTED REFERENCES

Bureau of Water Quality Control, 1978, Drinking water regulations for

The Supai Group is the source of a spring in sec. 28, T. 33 N., R. 7 W.,

that is estimated to discharge 1 gal/min. Magnesium, calcium, and

bicarbonate are the dominant chemical constituents in the water. The

dissolved-solids concentration is 335 mg/L, and the fluoride concen-

The Muav Limestone yields water to several springs that reportedly

discharge 1 to more than 16,700 gal/min in the southern and southeastern

points from the aquifer. Tapeats Spring discharges about 16,700 gal/min,

and Thunder Spring discharges about 7,400 gal/min (Johnson and Sanderson,

parts of the area. Tapeats and Thunder Springs are the main discharge

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5	0		5 MILES
5	0	5	10 KILOMETER
	CONTOUR INTERVAL 200 FEET WITH SUPPLEMENTARY CONTOURS AT 100-FOOT INTERVALS DATUM IS MEAN SEA LEVEL		

Composite stratigraphic column for the Kanab area Letter symbol Group, formation, for geologic unit System or member Alluvium Qal Quaternary Quaternary and Basalt QTb Tertiary Jurassic and Navajo Sandstone JEn Triassic(?) N aquifer Kayenta Formation Triassic(?) Temo, Moenave Formation Tec Chinle Formation Petrified Forest Triassic Rcs Rm Shinarump Member Moenkopi Formation Kaibab Limestone Toroweap Formation Permian Coconino Sandstone Hermit Shale Ph Supai Group Callville Limestone PIPs Permian and PIPC Pennsylvanian Mississippian Redwall Limestone Dtb Devonian Temple Butte Limestone €m Muav Limestone Cambrian Bright Angel Shale €ba Tapeats Sandstone

foot [(gal/min)/ft]

15M(1976)